

EXTERNAL FEATURES OF AN EARLY HUMAN EMBRYO WITH A DISTENDED AMNION. By C. J. PATTEN, Sc.D.

(Read before the Anatomical Society of Great Britain and Ireland, at Birmingham, 26th June 1908.)

A LITTLE time ago my colleague, Dr Arthur Hall, kindly handed me over for the Anatomical Museum, among other specimens, a human embryo 5 mm. in length. No history as to how the specimen was obtained can be traced, but apparently it was expelled from the uterus as a "miscarriage," the membranes and deciduæ being intact. An oval-shaped tumour (length 2·5 cm., breadth 1·5 cm.), hard and dense, which on section proved to be a blood-clot, was found attached to one end of the mass (fig. 1, *c*). From inquiries made, it would seem that the specimen had lain in spirit for many years in the Pathological Museum of the old University College. It was suspended in a glass jar by means of a wire passed through the blood-clot and attached to the lid. Except that neither the clot nor the amnion had been cut into, the specimen, when I received it, appeared as in fig. 1, which is a reproduction of a photograph of natural dimensions. The abnormal position of the amnion, dislodged from the chorionic vesicle, and hanging as a pear-shaped bag, attracted attention, but its immense size struck one as much more peculiar. The maximum length and breadth of the unopened sac measured respectively 3·2 cm. and 2·2 cm., which were altogether disproportionate to the size of the minute embryo contained within. In fact, when replaced the amnion not only filled but pressed upon the cavity of the chorion, though normally the obliteration of the extra-embryonic cœlom does not take place before the embryo is eight weeks old and would measure about 30 mm. The body-stalk was relatively short, so that the embryo occupied the upper part of the sac (fig. 1, *f*), as contrasted with the position which the long stalk of an embryo of later date permits. The amnion in question had evidently undergone abnormal distension. It was filled with a light yellowish-red fluid which took from its translucency, obscuring the embryo to such an extent that the latter appeared little more than a minute dark shadow within. Fearing that I had lost my bearings and that the supposed amnion was perhaps some part of the chorionic investment split off¹ and that a closely investing membrane was yet to be

¹ I may here state that, in addition to the thick trophoblastic layer of the chorion profusely beset with villi, the mesodermic layer was present in the form of a thin and very

discovered, I proceeded with as much caution as possible to explore the interior of the sac by cutting a window in it over the area where the embryo was suspended (fig. 1, *a, f*). The first slight snip made with a finely pointed pair of scissors demonstrated the distensibility of the sac by



FIG. 1.—The embryo *in situ* and its surrounding tissues. (Nat. size.) The specimen was photographed under spirit after the amnion had been opened and the turbid liquor amnii removed by gentle irrigation through a finely pointed pipette.

The enlarged amniotic sac (*a*), displaced from the chorionic vesicle (*b*), hangs downwards. A window has been cut into the sac to allow the contained embryo (*f*) to come into view. The chorionic villi (*c*) are seen connected with the decidua (*d*). The oval-shaped blood-clot (*e*) is attached at the upper end of the decidua.

N.B.—This photograph being natural size, it may be of interest to give the following measurements :—

Total length from top of clot to tip of amnion, 9.1 cm.
 Greatest length of amnion, 3.2 cm. ; greatest breadth, 2.2 cm.
 Longest measurement of clot, 2.5 cm. ; broadest, 1.5 cm.
 Greatest length of chorionic cavity, 3.4 cm.

the rush of semi-turbid fluid which, when cleared away by gentle irrigation with clean spirit through a fine pipette, left the amniotic wall as clear delicate membrane loosely adherent to the trophoblastic layer, and from which it easily separated. *A priori*, therefore, the supposed amnion could not have been the inner layer of the chorion. Indeed, as the text shows, it proved to be the true amniotic covering.

as usual. The opacity, therefore, was not due to thickenings of the wall, but to the turbidity of the contained fluid. I next looked carefully for a closely investing membrane, but found the embryo free from such. Distension of the amnion by an unusually large quantity of liquor amnii, associated with an embryo of so early a stage of development, appears to be a very rare condition. I do not pretend to offer a satisfactory explanation, but may say in passing that I have found somewhat parallel instances among avian embryos which had been killed by raising the temperature of an incubator to 46° C. and over. In three species—House-sparrow, Song-thrush, and Blackbird—the amnion was hyper-distended with fluid. Indeed, it may be suggested that the inflammatory conditions which induced the hæmorrhage may have been accompanied by a rise in temperature sufficient to kill the human embryo in question and, moreover, to call forth an exudation of liquor amnii with excessive distension of the sac; for, as shall be pointed out presently, the embryo bore evident signs that it had been dead some time before it was expelled from the uterus.

I next photographed the embryo *in situ*, and then proceeded to free it from its connection with the amnion. In this attempt a portion of the pear-shaped yolk-sac came away. It communicated by a wide neck with the alimentary canal, and was about two-thirds the length (in its longest dimension) of the body of the embryo. In fig. 2 the parts which are intact, *b* and *c*, together with the area enclosed within the dotted line, indicate the shape and the size relative to the embryo. The distal end of the short body-stalk, where it was disconnected from the amnion, was expanded and disc-like (fig. 2, *a*). Both it and the yolk-sac were exceedingly thin and frail. The embryo, while retaining its natural shape, was soft and cheese-like in consistency, and so fragile as to allow of little manipulation even with a soft camel-hair brush. It evidently died *in utero* and remained for some days soaking in the liquor amnii. There is no evidence to show that the deterioration of the tissues was due to neglect in preserving the specimen after it had been secured; for the clot, deciduæ, chorionic villi, and membranes are well preserved, having probably retained their vitality for a considerable time after the death of the embryo.

Examined in spirit, the embryo was of a greyish-white colour and very opaque. The mouth, bounded above by the prominent fore-brain and below by a well-developed mandibular arch and prominent heart, the optic vesicle, the four limb-buds (just appearing as slight prominences), the downwardly directed tail, and a rather sharp dorsiflexion opposite the arm-buds were about the only features that could be made out.

On passing the specimen through a series of diluted baths until pure water was reached, several other details became apparent. Examined under

water after two hours' soaking, the embryo showed a well-marked, pit-like, depression immediately below the mandibular arch. Microscopic examination with careful focussing further revealed a delicate linear shading extending backward and upward. The whole I take to be the hyo-mandibular cleft; this is bounded below by a short and less distinctly

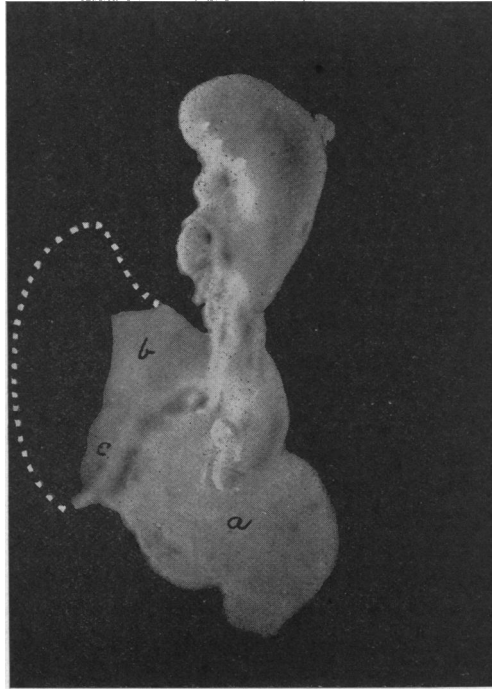


Fig. 2.—Embryo from the left side. The photograph was taken as the embryo lay in water in which it had previously soaked for two hours, having been removed from spirituous solutions.

Below the heart and separated by a tag of membrane is the right arm-bud, shaped like a minute bi-convex lens. The left arm-bud is also visible as a slight and somewhat shaded prominence opposite the sharpest bend of the back, below which several mesoblastic somites are faintly discernible. The left leg-bud, fissured transversely, appears as a distinct oval-shaped elevation a little way above the point of the tail. Opposite the leg-bud a gentle convexity of the dorsal surface indicates the position of the commencing sacral bend. The lower end of the body-stalk (a) appears as a wide flattened disc on which the tail-end of the embryo rests. The portions of the yolk-sac which remained intact are lettered b and c. The dark area enclosed within the dotted line represents what was torn away. The other features of the embryo can be made out from the description in the text, and a reference to fig.3(lettered).

marked ridge—the hyoidean arch. Ventrally, this arch appears to join the mandibular arch. Another pit-like depression, extending a short distance backward as a faint linear shading and presumably the second branchial cleft, appears below the hyoidean arch.

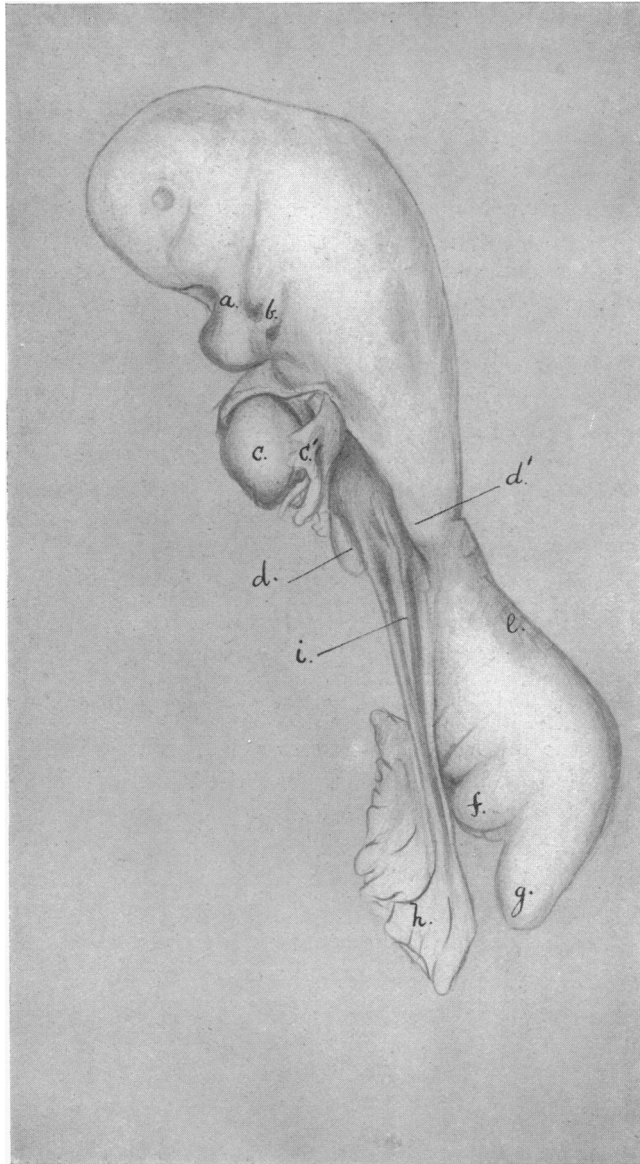


Fig. 3.—Drawing of the embryo from the left side. The drawing was made when the embryo was under water and had been soaking two hours after the photograph (fig. 2) was taken.

a, mandibular arch; *b*, hyoidean arch. Between *a* and *b* is seen the hyo-mandibular cleft, represented by a deep pit ventrally and a thin linear shading when followed backward. Below *b* is the second branchial cleft, also seen as a distinct pit-like depression in front but shading off indistinctly when traced backward; *c*, heart; *c'*, pericardium, showing torn ends; *d*, right arm-bud; *d'*, left arm-bud; *e*, mesoblastic somites, very indistinct; *f*, left leg-bud; *g*, tail, downwardly directed; *h*, remains of allantois; *i*, neck of yolk-sac, whose thin walls have collapsed and closed the cavity.

Though I allowed the embryo to remain some hours longer in water, until the parts visible in spirit became much more clearly defined, and indications of mesoblastic somites could be faintly discerned below the dorsiflexions (figs. 2 and 3), I am satisfied that no other traces of gill-slits could be found. Comparing this embryo with others, it may be seen that the downwardly directed tail, sharp back curve (dorsiflexion), large wide-necked yolk-sac, wide body-stalk, prominent bent tubular heart, and the presence of only two gill-slits¹ would point to characteristics of an embryo of smaller size and earlier date. Such, for instance, are, for the most part, to be made out in His's Lg embryo, which is only 2.15 mm. long, though here the dorsiflexion is more pronounced. While often accompanying embryos of between 2 and 3 mm. long, still the dorsiflexion varies considerably in extent: for instance, in Kollmann's embryo, 2.4 mm., the dorsal surface of the body, though not sharply bent like that of His's Lg embryo, is distinctly concave from before backward, while Professor Peter Thompson's² specimen of the same dimensions shows no dorsiflexion, the whole back being evenly convex, and the head and tail curved toward each other.

On the other hand, the fuller and more rounded head, conspicuous eye-vesicle, and mandibular arch, with the first indications of the limb-buds, recall the features of His's Lr embryo of 4.2 mm. long, estimated at about three weeks old. The main difference is that in the latter the dorsiflexion has almost entirely disappeared and has been replaced by a distinct ventral bending of both the anterior and posterior parts with marked convexities over the head and neck and sacral regions, the tail being distinctly curled upward. In this embryo a third branchial cleft is figured as well as a distinct otic vesicle.

With regard to the chorion there is little to add beyond noting that it was well developed, and villi covered its entire surface, being specially well marked and thick at the region most remote from the blood-clot (fig. 1). The average length of the villous tufts, measured from their roots on the outer surface of the trophoblastic chorion to their attachments in the deciduæ, was about 8 cm. Taken as a whole, the villi varied from thick, irregular, lobed processes to slender, dendritic arborisations. The delicate inner chorionic mesoderm could be separated without difficulty from the stout outer trophoblastic layer.

¹ Unless the other two gill-slits had already closed up.

² In this specimen the head is "small, somewhat flattened from above downward and pointed," differing considerably from the form of head in most young human embryos.

SUMMARY.

Useless as the embryo above described may be for cutting and mounting, it lacks nothing in the perfection of its external form ; indeed, the word "pathological," often too loosely applied in embryology, would here be quite inapplicable. This, coupled with the fact that early human embryos are difficult to procure, leads me to believe that, handicapped though I have been in my attempts to describe and figure so frail a specimen, such will not be devoid of interest. An examination of the external features alone of this specimen affords us another striking instance of the wide range of variation to be met with in embryos of somewhat the same size and supposed age. If adherence to type be strictly enforced, the embryo here described is decidedly aberrant. Some of its features point to precocity of development ; others to tardiness.

When one considers not only the remarkable differences noticeable in the early post-natal development of large clutches of birds and litters of mammals, but also in the pre-natal growth of several embryos within the same uterus, and, less frequently, though by no means rarely, of twins, it would seem almost surprising than otherwise if human embryos of similar period, but from different uteri, should reach with any degree of constancy the same state of development and exhibit the same external features.

In conclusion, I wish to express my indebtedness to Dr W. J. Vincent for the drawing he so kindly made, from which fig. 3 has been prepared.